SCIENCE

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THE MOST DESTRUCTIVE TORNADOES SINCE 1872.

A GOOD many rather imperfect lists have been published from time to time, which have not had sufficient care manifested in their collation. There are several peculiar difficulties which one meets in this work. For example: each of three different men at three towns makes a report of a tornado, presumably in the town. One makes the property loss $25,000, and the number of killed, 8; while the second makes these $100,000 and 9, and the third $200,000 and 12, respectively. Fortunately a request was made for the names of the persons killed, and it was found that 8 of them were the same in all three reports, showing that the same tornado had been described. It would have been a very easy matter to have considered the loss of life 29, and of property $325,000, if these had been regarded as different. In another case there were found four tornado lists, two of them containing over 2,000 in each list. One of these was given as occurring near Erie, Penn., on July 26, 1875, in the afternoon. The condition before the storm was "very sultry," and after it, "chilly;" the destructive winds had a motion first from "south-west," then "north-west, west, and north;" while the rain was given as falling "after" the tornado. One hundred and thirty-four lives were lost, and property valued at $500,000 was destroyed. This whole account was so circumstantial and straightforward, that it was very remarkable to find no mention of such a destructive storm in the *Weather Review*. After a search of a good many days, it was at last found that this loss of life and property occurred from a flood near Pittsburgh, Penn., on July 26, 1874.

The *Weather Review* has been appealed to in determining what storms should go into the list below, as it does not appear probable that any notable tornado would be overlooked in that. The criterion for destructiveness has been not entirely the loss to structures, but the violence of the storm, the loss of life, etc., have entered into the estimate. It is not expected that this list will prove entirely satisfactory: in fact, it has already been changed slightly since its first preparation in June, 1889. The utmost pains have been taken to make it reliable, and, if there has been any error, it has been in the line of allowing too much loss rather than too little in any individual case.

(1) Nov. 22, 1874. Tuscumbia, Colbert County, Ala. (scale 3).—Struck the town at 6 P.M.; nearly half the town of 1,400 inhabitants destroyed; 10 persons killed, and 30 wounded; 100 buildings damaged or destroyed; loss, $100,000 (estimated).

(2) May 6, 1876. Chicago, Cook County, Ill. (scale 3).—Moved from south-west to north-east, accompanied by rain, thunder, and lightning; bounding like a ball, it apparently reached the ground but two or three times; loss, $250,000.

(3) June 4, 1877. Mount Carmel, Wabash County, Ill. (scale 3+).—200 to 400 feet wide; great destruction of property; 16 killed, 100 wounded; loss, $400,000.

(4) July 7, 1877. Pensaukee, Oconto County, Wis. (scale 3).—Moved from north-west to south-east, lasting about 2 minutes; 8 killed, many wounded; loss, $300,000.

(5) June 1, 1878. Richmond, Ray County, Mo. (scale 3).—Entered the town at 4.5 P.M. from the south, sweeping every thing clean; heavy sills 18 inches square and 16 feet long were swept away; path through the city 750 feet wide and 1 mile long, in which space not a single house was left; 13 killed, 70 wounded; 100 buildings damaged or destroyed; loss, $100,000 (estimated).

(6) Aug. 9, 1878. Wallingford, New Haven County, Conn. (scale 3+).—At 5.45 P.M. a dark cloud approached from the west; "electricity of the most terrific kind filled the air;" "straight rods of fire came down from the sides of the cloud to the earth; the *débris* of houses was scattered along in parallel lines, as though a mighty river had passed; the greatest destruction occurred in a path 400 feet wide and half a mile long; 34 killed, 70 wounded; 40 dwellings, 50 barns, 1 church, and 1 schoolhouse were destroyed or badly damaged; loss, $200,000.

(7) April 14, 1879. Collinsville, Madison County, Ill. (scale 3—).—Struck town at 2.45 P.M.; nearly every gravestone in cemetery was levelled; 1 killed, several wounded; 60 buildings destroyed; loss, $50,000.

(8) April 16, 1879. Walterboro, Colleton County, S.C. (scale 3).—Rainfall after tornado, which struck at 3.45 P.M., was unprecedented; wind on north side had a downward crushing tendency, on the south side an upward lifting action; 4 people saw balls of lightning running along the ground; 16 killed; 50 buildings destroyed; loss, $200,000.

(9) March 4, 1880. Indianapolis, Marion County, Ind. (scale 3—).—Moved from south-west to north-east with a zigzag course through the city; loss, $100,000.

(10) April 18, 1880. Fayetteville, Washington County, Ark. (scale 3).—Struck town at 8.30 P.M.; not a building escaped in its path, 90 feet wide, through the

town; 2 killed, 20 to 30 injured; 100 buildings destroyed; loss, $100,000.

(11) April 18, 1880. Marshfield, Webster County, Mo. (scale 3).—Struck at 5 P.M.; near town, trees 3 feet in diameter, for a space several hundred yards wide, were lifted entirely out of the ground; every house in the town of 2,000 people was destroyed or badly damaged; 65 killed, 200 wounded; loss, $110,000.

(12) April 18, 1880. Licking, Texas County, Mo. (scale 3—). —Struck at 8.15 P.M.; entire town, of 388 people, destroyed except 3 houses; 300 left homeless; 1 killed, 17 wounded; 65 houses destroyed; loss, $50,000.

(13) April 18, 1880. Beloit, Rock County, Wis. (scale 3—). —Struck at 5 P.M.; moved from south-west to north-east; several killed, many injured; many houses destroyed; loss, $75,000.

(14) April 24, 1880. Taylorville, Christian County, Ill. (scale 3—).—Struck at 7 P.M.; 6 killed; 25 houses destroyed; loss, $60,000.

(15) April 25, 1880. Macon, Noxubee County, Miss. (scale 3).—Struck at 8.30 P.M.; 22 killed, 72 injured; 55 buildings destroyed; loss, $100,000.

(16) May 10, 1880. Arrowsmith, McLean County, Ill. (scale 3—).—Loss, $100,000.

(17) May 28, 1880. Savoy, Fannin County, Tex. (scale 3—).—Time, 10 P.M.; town almost destroyed; 15 killed, 60 wounded; 48 buildings razed; loss, $50,000.

(18) June 14, 1880. Glendale, Hamilton County, O. (scale 3—).—Time, 8 P.M.; loss, $80,000.

(19) April 12, 1881. Hernando, De Soto County, Miss. (scale 3—).—In some spots hail-stones as large as hen's eggs fell; electricity and thunder not observed; 10 killed; 25 buildings demolished; loss, $50,000 (estimated).

(20) June 12, 1881. Jackson, Andrew County, Mo. (scale 3).—A great deal of destruction occurred at King City, De Kalb County; in county and vicinity, 5 killed; 80 buildings razed; loss, $250,000.

(21) July 15, 1881. New Ulm, Brown County, Minn. (scale 3+).—11 killed, 53 wounded; nearly 300 buildings destroyed or seriously damaged; loss in town, $400,000.

(22) Sept. 24, 1881. Quincy, Adams County, Ill. (scale 3).—Time, 5 P.M.; storm accompanied by terrific lightning and thunder; 9 killed; 21 buildings razed; loss, $100,000.

(23) April 18, 1882. Brownsville, Sabine County, Mo. (scale 3).—Time, 4.20 P.M.; 8 killed; 10 brick houses, 40 others, and 1 school razed; loss, $150,000.

(24) May 8, 1882. McKinney, Cleveland County, Ark. (scale 3—).—50 buildings destroyed; loss, $30,000.

(25) May 8, 1882. Mount Ida, Montgomery County, Ark. (scale 3—).—Time, 5.30 P.M.; 2 killed; 100 buildings demolished; loss, $50,000.

(26) June 17, 1882. Grinnell, Poweshiek County, Io. (scale 3+).—Time, 8.45 P.M.; 60 killed, 150 injured; 140 houses reduced to ruins in 5 minutes; loss, $600,000.

(27) April 22, 1883. Beauregard, Copiah County, Miss. (scale 3+).—Time, 3 P.M.; every house and store destroyed in the town of 600 people; solid iron screw of a cotton-press weighing 675 pounds was carried 900 feet; 29 killed, 40 wounded; loss, $450,000.

(28) April 22, 1883. Wesson, Copiah County, Miss. (scale 3—).—13 killed, 60 injured; 27 houses destroyed; loss, $20,000.

(29) May 13, 1883. Kansas City, Jackson County, Mo. (scale 3).—Time, 8.30 P.M.; 200 houses destroyed; loss in town and vicinity, $300,000.

(30) May 13, 1883. Macon City, Macon County, Mo. (scale 3—).—Time, 8.30 P.M.; 5 killed; 107 buildings razed; loss, $150,000. This destruction and loss may include the whole county.

(31) May 18, 1883. Oronogo, Jasper County, Mo. (scale 3—).—6 killed, 33 injured; nearly all houses destroyed; loss, $75,000.

(32) May 18, 1883. Racine, Racine County, Wis. (scale 3—).—Time, 7 P.M.; 16 killed, 100 injured; loss, $75,000.

(33) June 2, 1883. Greenville, Hunt County, Tex. (scale 3—).—Time, 7.15 P.M.; 1 killed, several wounded; 40 houses razed; loss, $70,000.

(34) June 11, 1883. Brush Creek, Fayette County, Io. (scale 3—).—Town one-third destroyed; loss, $40,000.

(35) Aug. 21, 1883. Rochester, Olmstead County, Minn. (scale 3).—Time, 6.36 P.M.; large part of town destroyed; 26 killed; 135 houses destroyed; loss in county, $200,000.

(36) Feb. 19, 1884. Leeds, Jefferson County, Ala. (scale 3—).—Time, 1.20 P.M.; hail of unusual size; 11 killed, 31 wounded; 27 houses and many barns destroyed; loss, $80,000 (estimated).

(37) April 27, 1884. Jamestown, Greene County, O. (scale 3).—Time, 5 P.M.; 6 killed; two-thirds of buildings destroyed; loss, $200,000.

(38) July 21, 1884. Dell Rapids, Minnehaha County, Dak. (scale 3).—Time, 3.5 P.M.; 7 killed; many buildings destroyed; loss, $100,000.

(39) Sept. 9, 1884. Clear Lake, Polk County, Wis. (scale 3). —Time, 5 P.M.; greater part of town in ruins; 3 killed; 40 buildings destroyed; loss, $150,000.

(40) Aug. 3, 1885. Camden, Camden County, N.J. (scale 3+).—Time, 3.20 P.M.; path from one to two squares wide; 6 killed, 100 injured; 500 houses razed or unroofed; loss, $500,000.

(41) Sept. 8, 1885. Washington Court House, Fayette County, O. (scale 3+).—Time, 7.30 P.M.; width of path, 250 feet; town almost destroyed; 6 killed, 100 injured; 40 business-houses and 200 residences razed; loss, $500,000.

(42) April 14, 1886. Coon Rapids, Carroll County, Io. (scale 3—).—Time, 5.5 P.M.; 1 killed; 32 buildings razed; loss, $55,000.

(43) April 14, 1886. St. Cloud, Stearns County, and Sauk Rapids, Benton County, Minn. (scale 3+).—74 killed, 136 wounded; 138 buildings destroyed; loss, $400,000.

(44) May 12, 1886. Attica, Fountain County, Ind. (scale 3).—Time, 10 P.M.; in vicinity, 9 killed; 200 houses razed; loss, $200,000.

(45) April 15, 1887. St. Clairsville and Martin's Ferry, Belmont County, O. (scale 3). Time, 3.20 P.M.; none killed; about 200 buildings of all kinds demolished; loss, $250,000.

(46) April 21, 1887. Prescott, Linn County, Kan. (scale 3). —Time, 5.30 P.M.; 20 killed, 237 wounded; 330 buildings razed in vicinity; loss, $150,000.

(47) April 22, 1887. Mount Carmel (near), Wabash County, Ill. (scale 3 —).—Time, 6 P.M.; 2 killed, several wounded; every thing in path destroyed; loss, $50,000.

(48) April 22, 1887. Clarksville (near), Johnson County, Ark. (scale 3).—Time, 6.30 A.M.; 20 killed, 75 to 100 injured in vicinity; loss, $150,000.

(49) June 16, 1887. Grand Forks, Grand Forks County, Dak. (scale 3).—Time, 3.22 P.M.; 4 killed; 50 or more houses, besides hundreds of barns, etc., razed; loss, $150,000.

(50) Feb. 19, 1888. Mount Vernon, Jefferson County, Ill. (scale 3+).—18 killed, 54 wounded; 100 buildings razed; loss, $400,000.

(51) May 27, 1888. Hillsboro, Hill County, Tex. (scale 3 —).—Many buildings razed; loss, $100,000.

(52) Aug. 21, 1888. Wilmington, New Castle County, Del. (scale 3).—1 killed, 20 wounded; loss $100,000 to $200,000.

(53) Jan. 9, 1889. Brooklyn, Kings County, N.Y. (scale 3).—Time, 7.40 P.M. (Eastern); width, 500–600 feet; length, 2 miles; whirl from right to left; roar heard 10 or 15 minutes before; loss, $300,000.

(54) Jan. 9, 1889. Reading, Berks County, Penn. (scale 3). —Time, 5.40 P.M.; swept from west to east in a path 60 to 100 feet wide; wind often seemed to crush from above; 40 killed; loss, $200,000 (estimated).

(55) Jan. 12, 1890. St. Louis, St. Louis County, Mo. (scale 3).—Time, 4 P.M.; moved to north-east in a path 500 to 2,000 feet wide; heavy rain for 3 minutes; greatest damage where path was narrowest; 3 killed; 100 houses razed; loss, $250,000.

(56) March 27, 1890, Metropolis, Massac County, Ill. (scale 3 —).—1 killed, 50 injured; loss, $150,000.

(57) March 27, 1890. Louisville, Jefferson County, Ky. (scale 3+).—Time, 7.57 P.M.; path at beginning 600 feet, as it left the city 1,500 feet; cloud did not quite reach the earth; great damage to property; 76 killed, 200 injured; loss, $2,250,000.

This list comprises all the most destructive storms that have been reported, as far as a definite locality was mentioned. It has been found exceedingly difficult to determine the loss in many cases, because an estimate has evidently been made of the loss to crops, orchards, etc., from the rain, hail, and floods that accompanied the tornado, and not from the wind itself. Again, the loss reported evidently referred to a large region in the county, and not to any specific town. Some of these may be enumerated as follows:—

DATE.	COUNTY.	STATE.	LOSS.
June 12, 1881	DeKalb and others.	Missouri.	$200,000
Nov. 5, 1883	Greene and others.	Missouri.	150,000
Nov. 21, 1883	Izard.	Arkansas.	300,000
April 14, 1886	Cass.	Iowa.	160,000
May 11, 1886	Pettis and others.	Missouri.	500,000
May 12, 1886	Greene and others.	Ohio.	1,000,000
May 14, 1886	Hardin and others.	Ohio.	720,000
May 14, 1886	Huron.	Ohio.	500,000
May 14, 1886	Seneca.	Ohio.	300,000
May 14, 1886	Mercer.	Ohio.	250,000

It is highly probable that in some of these cases the losses from one county have been estimated in another, though this has been avoided as much as possible. It is very much to be hoped that more definite estimates will be made in the future. The loss to structures by the wind should be carefully distinguished from the loss of every other kind, by hail or flood, and to crops, stock, or orchards. I shall be very grateful to any who will send me corrections to this list, or add other tornadoes. H. A. HAZEN.

LIGHTNING-CONDUCTORS FROM A MODERN POINT OF VIEW.[1]

A LIGHTNING-CONDUCTOR used to be regarded as a conduit or pipe for conveying electricity from a cloud to the ground. The idea was, that a certain quantity of electricity had to get to the ground somehow; that if an easy channel were opened for it the journey could be taken quietly and safely, but that if obstruction were opposed to it violence and damage would result. This being the notion of what was required, a stout copper rod, a wide-branching and deep-reaching system of roots to disperse the charge as fast as the rod conveyed it down, and a supplement of sharp points at a good elevation to tempt the discharge into this attractive thoroughfare, were the natural guaranties of complete security for every thing overshadowed by it. Carrying out the rain-water-pipe analogue, it was natural also to urge that all masses of metal about the building should be connected to the conductor, so as to be electrically drained to earth by it; and it was also natural to insist on very carefully executed joints, and on a system of testing resistance of conductor and "earth," so as to keep it as low as possible. If ever the resistance rose to 100 ohms, it was to be considered dangerous.

The problem thus seemed an easy one, needing nothing but good workmanship and common sense to make accidents impossible. Accordingly, when, in spite of all precautions, accidents still occurred; when it was found that from the best-constructed conductors flashes were apt to spit off in a senseless manner to gun-barrels and bell-ropes, and wire fences and water-butts,—it was the custom to more or less ridicule and condemn either the proprietor of the conductor, or its erector, or both, and to hint that if only something different had been done,—say, for instance, if glass insulators had not been used, or if the rod had not been stapled too tightly into the wall or if the rope had not been made of stranded wires, or if copper had been used instead of iron, or if the finials had been more sharply pointed, or if the earth-plate had been more deeply buried, or if the rainfall had not been so small, or if the testing of the conductor for resistance had been more recent, or if the wall to which the rod was fixed had been kept wet, etc.,—then the damage would not have happened. Every one of these excuses has been appealed to as an explanation

[1] By Professor Oliver J. Lodge (from Industries).

of a failure; but because the easiest thing to abuse has always been the buried earth connection, that has come in for the most frequent blame, and has been held responsible for every accident not otherwise explicable.

All this is now changing or changed. Attention is now directed, not so much to the opposing charges in cloud and earth, but to the great store of energy in the strained dielectric between. It is recognized that all this volume of energy has somehow to be dissipated, and that to do it suddenly may be by no means the safest way. Given a store of chemical energy in an illicit nitroglycerine factory, it could be dissipated in an instant by the blow of a hammer; but a sane person would prefer to cart it away piecemeal, and set it on fire in a more leisurely and less impulsive manner. So, also, with the electrical energy beneath a thunder-cloud. A rod of copper an inch or a foot thick may be too heroic a method of dealing with it; for we must remember that an electric discharge, like the recoil of a spring or the swing of a pendulum, is very apt to overshoot itself, and is by no means likely to exhaust itself in a single swing. The hastily discharged cloud (at first, suppose, positive) over-discharges itself, and becomes negative; this again discharges and over-discharges till it is positive, as at first; and so on, with gradually diminishing amplitude of swing, all executed in an extraordinarily minute fraction of a second, but with a vigor and wave-producing energy which are astonishing: for these great electrical surgings, occurring in a medium endowed with the properties of the ether, are not limited to the rod or ostensible conduit. The disturbance spreads in all directions with the speed of light; and every conducting body in the neighborhood, whether joined to the conductor or not, experiences induced electrical surgings to what may easily be a dangerous extent: for not only is there imminent danger of flashes spitting off from such bodies for no obvious reason, — splashes which, on the drain-pipe theory, are absolutely incredible; flashes sometimes from a perfectly insulated, sometimes from a perfectly earthed, piece of metal, — but, besides this, remember that near any considerable assemblage of modern dwellings there exists an extensive metallic ramification in the gas pipes, that these are in places eminently fusible, and that the substance they contain is readily combustible.

On the drain-pipe theory, the gas-pipes, being perfectly earthed, would be regarded as entirely safe so long as they were able to convey the current flowing along them without melting; but, on the modern theory, gas-pipes constitute a widely spreading system of conductors, able to propagate disturbance under ground to considerable distances, and very liable to have some weak and inflammable spot at places where they are crossed by bell-wires, or water pipes, or any other metallic ramification.

Above ground we have electrical waves transmitted by the ether, and exciting surgings throughout a neighborhood by inductive resonance. Below ground we have electrical pulses conveyed along conductors, leaking to earth as they go, but retaining energy sufficient to ignite gas, whenever conditions are favorable, at considerable distances.

The problem of protection, therefore, ceases to be an easy one, and violent flashes are to be dreaded, no matter how good the conducting-path open to them. In fact, the very ease of the conducting-path, by prolonging the period of dissipation of energy, tends to assist the violence of the dangerous oscillations. The drain-pipe theory, and the practical aphorisms to which it has given rise, would serve well enough if lightning were a fairly long-continued current of millions of ampères urged by a few hundred volts, or if there were no such thing as electro-magnetic inertia; but seeing that the inverse proportion between ampères and volts better corresponds to fact, and seeing that the existence of electro-magnetic inertia is emphasized by multitudes of familiar experiments, the drain-pipe theory breaks down hopelessly, and only a few of its aphorisms manage to survive it.

What, then, are we to set up in place of this shattered idol? First of all, we can recognize what was virtually suggested by Clerk Maxwell, — that the inside of any given enclosure, such as a powder-magazine or dynamite-factory, can, if desired, be absolutely protected from internal sparking by enclosing it in a metallic cage or sheath, through which no conductor of any kind is allowed to pass without being thoroughly connected to it. The clear recognition of the exact, and not approximate, truth of this statement is a decided step in advance, and ought to be satisfactory to those who have to superintend the practical protection of places sufficiently dangerous, or otherwise important, to make the aiming at absolute security worth while. Similarly, for wire-covered ocean-cables absolute protection is possible; but not for ordinary buildings, any more than for ordinary land telegraph-offices, is such a plan likely to be adopted in its entirety. Some approximation to the cage system can be applied to ordinary buildings in the form of wires along all its prominent portions; and such a plan I have suggested, and I understand it is being carried out, for the entrance towers and part of the main body of the present Edinburgh electrical exhibition, Mr. A. R. Bennett having asked me to recommend a plan to the committee as a sort of exhibit. For chimneys a set of four galvanized iron wires, joined by hoops at occasional intervals, and each provided with a fair earth, seems a satisfactory method; but it is to be noted that a column of hot air constitutes a surprisingly easy path, and that it is well to intercept a flash on its way down the gases of a chimney by a copper hoop or pair of hoops over its mouth. Mr. Goolden tells me that he has just applied this method to a new chimney at his works in the Harrow Road. For ordinary houses, a wire down each corner and along the gables is as much as can be expected. At many places even this will not be done. A couple of vertical wires from the highest chimney-stacks on opposite sides must be held better than nothing or than only one.

Earths will be made, but probably they will be simple ones, entailing no great expense. A deep, damp hole for each conductor, with the wire led into it, and twisted round an old harrow or a load of coke, may be held sufficient. And as to terminals, rudely sharpened projections as numerous as is liked may be arranged along ridges and chimney-stacks; but I have at present no great faith in the effective discharging-power of a few points, and should not be disposed to urge any considerable expense in erecting or maintaining them. Crowns of points on chimneys and steeples are certainly desirable, to ward off, as far as they can, the chance of a discharge; but a multitude of rude iron ones will be more effective than a few highly sharpened platinum cones. I find that points do not discharge much till they begin to fizz and audibly spit; and, when the tension is high enough for this, blunt and rough terminals are nearly as efficient as the finest needle-points. The latter, indeed, begin to act at comparatively low potentials; but the amount of electricity they can get rid of at such potentials is surprisingly trivial, and of no moment whatever when dealing with a thunder-cloud.

But the main change I look for in the direction of cheapness and greater universality of protection is in the size and material of the conducting-rod itself. No longer will it be thought necessary to use a great thick conductor of inappreciable resistance: it will be perceived that very moderate thickness suffices to prevent fusion by simple current strength, and that excessive conducting-power is useless.

In the days when the laws of common "divided circuits" were supposed to govern these matters, the lightning-rod had to be of highly conducting copper, and of such dimensions that no other path to earth could hope to compete against it. But now it is known that low resistance is no particular advantage: it is not a question of resistance. The path of a flash is a question of impedance; and the impedance of a conductor to these sudden rushes depends very little on cross-section, and scarcely at all on material. A thin iron wire is nearly as good as a thick copper rod; and its extra resistance has actually an advantage in this respect, that it dissipates some of the energy, and tends to damp out the vibrations sooner. Owing to this cause, a side-flash from a thin iron wire is actually less likely to occur than from a stout copper rod.

The only limit is reached when the heat generated by the current fuses the wire, or runs the risk of fusing it; but, in so far as oscillations are prevented, the mean square of current strength on which its heating-power depends is diminished. Accordingly, a fairly thick iron wire runs no great risk of being melted. Its outer skin may, indeed, be considerably heated; for these sudden

currents keep entirely to the outer skin, penetrating only a fraction of a millimetre into iron, and they make this skin intensely hot. But the central core keeps cool until conduction has time to act; and consequently, unless the wire is so thin as to be bodily deflagrated by the discharge, its continuity is not likely to be interrupted. Thickness of wire is thus more needed in order to resist ordinary deterioration by chemical processes of the atmosphere than for any other reason.

But the liability to intense heating of the outer skin should not be forgotten, and care should be taken not to take the wire past readily inflammable substances for that reason. For instance: it would be madness to depend on Harris's notion that a lightning-conductor through a barrel of gunpowder was perfectly safe, especially if said conductor were an iron wire or rod.

In the old days a lightning-conductor of one or two hundred ohms resistance was considered dangerously obstructive, but the impedance really offered by the best conductor that ever was made to these sudden currents is much more like 1,000 ohms. A column of copper a foot thick may easily offer this obstruction, and the resistance of any reasonably good earth connection becomes negligible by comparison. A mere wire of copper or iron has an impedance not greatly more than a thick rod, and the difference between the impedance of copper and iron is not worth noticing.

But although, in respect of obstructing a flash, copper and iron and all other metals are on an approximate equality, it is far otherwise with their resistances, on which their powers of dissipating energy into heat depend. It is generally supposed that iron resists seven times more than copper of equal section, and so it does steady currents; but to these sudden flashes its resistance is often a hundred times as great as copper, by reason of its magnetic properties. This statement is quite reconcilable with the previous statement, that in the matter of total obstruction there is very little to choose between them: the apparent paradox is explicable by the knowledge that rapidly varying currents are conveyed by the outer skin only of their conductor, and that the outer skin available in the case of magnetic metals is much thinner than in the case of non magnetic.

Questions about shape of cross-section are rather barren. Thin tape is electrically better than round rod, but better than either is a bundle of detached and well-separated wires (for instance, a set of four, one down each cardinal point of a chimney); but it is easy to overestimate the advantage of large surface as opposed to solid contents of a conductor. The problem is not a purely electrical one: it is rather mixed. The central portion or core of a solid rod is electrically neutral, but chemically and thermally and mechanically it may be very efficient. It confers permanence and strength; and the more electrically neutral it is, the less likely is it to be melted. Its skin may be gradually rusted and dissolved off, or it may be suddenly blistered off by a flash; but the tenacity of the cool and solid interior holds the thing together, and enables it to withstand many flashes more. Very thin ribbon or multiple wire, though electrically meritorious, is deficient in these commonplace advantages.

There were two functions attributed to high conducting-power in the old days, — first, the overpowering of all other paths to earth; second, the avoidance of destruction by heat. The first we have seen to be fallacious: on the second a few more explanations can be made. In so far as fusion by simple current strength is the thing dreaded, it must be noticed that a good conductor has no great advantage over a bad conductor. It is a thing known to junior classes, that, when a given current has to be conveyed, less heat is developed in a good conductor, but that, when an electromotive force is the given magnitude, less heat is developed in a bad conductor. The lightning problem is neither of these, but it has quite as much relationship to the second as to the first. There is a given store of energy to be got rid of, and accordingly the heat ultimately generated is a fixed quantity. But the rise of temperature caused by that heat will be less in proportion as the production of it is slow; and though by sudden discharge a quantity of the energy can be made to take the radiant form, and spread itself a great distance before final conversion into heat, instead of concentrating itself on the conductor, yet this cannot be thought an advantage, for, just as in the old days a lightning-rod was expected to protect the neighborhood at its own expense by conveying the whole of a given charge to earth, so now it must be expected to concentrate energy as far as possible on itself, and reduce it to a quiet thermal form at once, instead of, by defect of resistance and over-violent radiation, insisting on every other metallic mass in its neighborhood taking part in the dissipation of energy.

The fact that an iron wire, such as No. 5 or even No. 8 B. W. G., is electrically sufficient for all ordinary flashes, and that resistance is not a thing to be objected to, renders a reasonable amount of protection for a dwelling-house much cheaper than it was when a half-inch copper rod or tape was thought necessary.

A recognition of all the dangers to which a struck neighborhood is liable, doubtless prevents our feeling of confidence from being absolute in any simple system of dwelling-house protection; but at the same time an amount of protection superior to what has been in reality supplied in the past is attainable now at a far less outlay, while for an expenditure comparable in amount to that at present bestowed, but quite otherwise distributed, a very adequate system of conductors can be erected.

Only one difficulty do I see. In coal-burning towns galvanized iron wire is, I fear, not very durable, and renewal expenditure is always unpleasant. It is quite possible that some alloy or coating able to avoid this objection will be forthcoming, now that inventors may know that the problem is a chemical one, and that high conductivity is unnecessary.

NOTES AND NEWS.

THE seventh annual meeting of the Association of Official Agricultural Chemists, by a vote of a majority of the executive committee, is called to meet in Washington, in the lecture-room of the National Museum, at 10 A.M., on the 28th of August proximo.

— Professor R. S. Woodward, for many years chief geographer of the United States Geological Survey, has been appointed assistant in the Coast and Geodetic Survey. Professor Woodward was for ten years assistant engineer on the United States Lake Survey, and was assistant astronomer of the United States Transit of Venus Commission previous to his connection with the Geological Survey. He was chairman of the Section of Mathematics and Astronomy of the American Association for the Advancement of Science in 1889, and is widely known for his investigations in mathematics, astronomy, and physics. His appointment to the Coast and Geodetic Survey is a subject for congratulation on both sides.

— Records have been received, at the office of the United States Coast and Geodetic Survey, of observations made during the last cruise of the "Pensacola." The stations include the West Coast of Africa, and some islands in the North and South Atlantic. The work was done by an officer of the survey, Assistant E. D. Preston, aided by members of the ship's company. Gravity and magnetic measures were made at St. Paul de Loanda (Angola), Cape of Good Hope, St. Helena, Ascension, Barbadoes, and Bermuda. In addition, magnetic observations alone were made at the Azores (Fayal), Cape Verde Islands (Porto Grande), Sierra Leone (Freetown), Gold Coast (Elmina), and in Angola at Cabiri. The pendulums used in the gravity work were the ones employed in 1883 in Polynesia, and in 1887 at the summit of Haleakala and other stations in the Hawaiian Islands. The computations are now under way at the office in Washington.

— Mr. Ward McAllister called at the office of the Cassell Publishing Company, New York, the day before he left New York for his farm at Newport, and delivered the manuscript of his book, "Society as I have found it," into the hands of the president of the company. Since he decided to write the book, Mr. McAllister has worked on it every day, and only completed it in time to leave town before the Fourth of July. A glance at the manuscript shows that it will more than fulfil the expectations of the public. No more interesting volume of its kind has been written since

Lord Chesterfield's letters, which it strongly resembles, for it combines reminiscence with instruction, precept and anecdote running side by side through its pages. A portrait of Mr. McAllister, taken expressly for the purpose, will form the frontispiece of the book.

— At the third summer meeting of university extension and other students, which is to be held at Oxford in August, as stated in *Nature*, Mr. E. B. Poulton, F.R.S., will lecture on the influence of courtship on color, and Mr. Francis Gotch on the physiology of the nervous system; Professor Patrick Geddes will deal with problems of evolution, organic and social; Professor Green, F.R.S., will give a course on geology; and Mr. C. Carus-Wilson lectures on geological phenomena. "The Teaching of Geography," by Mr. H. J. Mackinder; "Protective Adaptations in Plants," by Mr. J. B. Farmer; and "Some Aspects of Light," by M. V. Perronet Sells, — are also subjects announced in the programme.

— It will be remembered that a set of metric standards, furnished by the International Bureau of Weights and Measures near Paris, was brought to this country last autumn, and that they were formally received by the President of the United States, in the presence of a number of distinguished men. The other set allotted to this government, consisting of Metre No. 21 and Kilogram No. 4, has just been brought from Paris by Assistant O. H. Tittmann, and has been deposited at the office of United States Standard Weights and Measures in the Coast and Geodetic Survey building at Washington.

—Under the auspices of the Royal Dublin Society, and partially aided by government, a scientific investigation of Irish fishing-grounds is now being carried on upon the south-west and west coasts of Ireland, as stated in *Nature* of July 3. The Rev. W. Spotswood Green, her Majesty's inspector of fisheries, Dublin, and Professor A. C. Haddon of Dublin, organized the expedition, which is expected to last four or five months. The screw steamer "Fingal," of Glasgow, 160 tons register, chartered for the cruise, left Queenstown on May 7, having on board Mr. Green, Professor Prince, Mr. T. H. Poole of Cork (special surveyor to the expedition), and a crew of seamen experienced in trawl, net, and line fishing. Professor Prince, who has conducted elaborate investigations upon the embryology of food-fishes at St. Andrews, and, later on, Mr. E W. L. Holt, also of St. Andrews Marine Laboratory, superintended the zoölogical department until Professor Haddon was able to join the steamer. Dr. R. Scharff of the Science and Art Museum, Dublin, and other gentlemen, have temporarily assisted on board. The "Fingal" has been specially fitted up for the work. Several beam-trawls (including patent forms), a quantity of mackerel-nets, thirteen miles of long lines, large tow-nets (after Professor McIntosh's pattern), microscopes and instruments for zoölogical and physical research, are included among the appliances. The coast from Cape Clear to Killybegs Bay (Donegal) has already been traversed, and about thirty stations have been tested, and results of value obtained. In the open sea and in inshore waters the eggs and larval stages of mackerel, ling, gurnard, haddock, turbot, witch, and other species of food-fishes, have been obtained; and a great variety of invertebrates, including some rare echinoderms, annelids, mollusks, etc., have been brought up in the dredge and trawl, the greatest depth tested so far being about a hundred fathoms. The estuary of the Kenmare River, Dingle Bay, Smerwick, Birterburg, and Roundstone Bays, and the harbor of Clifden, proved to be very rich in invertebrate forms, specimens of *Synapta inhærens* being abundant, while *Bonellia*, *Priapulus*, and many rare mollusks, *Lyonsia*, *Philine*, and various nudibranchs, were procured. Copepods, larval crustaceans, medusæ, echinoderms, and ascidians occurred in such quantities as to frequently cause great inconvenience. A fine example of *Orthagoriscus mola*, nearly nine feet in dorso-ventral measurement, was shot by Mr. Green, and secured; and the rare pleuronectid, *Arnoglossus gröhmanii*, was obtained in Clifden harbor, the second specimen captured in British seas. Deep-sea dredgings will be taken, and it is expected that the reports to be presented at the end of the cruise to the Royal Dublin Society, to the Irish Fishery Department, and the government, will be of unusual scientific interest.

— Mr. W. C. Macdonald, a merchant of Montreal, has just made a munificent contribution to McGill College, says *Nature* of July 10. He has given $150,000 to the law faculty for the endowment of the dean's and another chair, and also $50,000 for the endowment of a chair of experimental physics, and has offered to erect buildings for the faculty of applied science, to include class-rooms and laboratories. Altogether the value of Mr. Macdonald's gift is about $400,000.

— The July number of the *Kew Bulletin* contains further information on the cultivation and preparation of the coloring-substance known as annatto. The present instalment deals with the West African seed, which does not appear to possess the qualities of that from Jamaica. A new method of preserving grain from weevils is suggested, while there is a long correspondence on Colombian india-rubber. The letters contain an account of a tree which yields rubber, and which is known in commerce as *Colombia virgen*. It has the peculiarity of growing at high elevations, and therefore in a comparatively cool climate. Another section deals with the fibre-industry of the Bahamas; and particulars are given of the establishment of the botanical station at Lagos, the first of its kind on the West Coast of Africa. A letter from the curator, Mr. McNair, gives interesting information respecting some of the plants under experimental cultivation there.

— We learn from *Nature* of July 10, that according to the report of the Oxford University extension scheme which has been issued, and which comes up to the commencement of July, "since June, 1889, 148 courses have been delivered in 109 centres by 25 lecturers. Examinations were held at the conclusion of 119 courses, and the examiners have awarded certificates of merit or distinction to 927 candidates. The courses were attended by 17,854 students, and the average period of study covered by each course was 10 weeks." In 1885–86 the number of courses delivered was 27 only, and the number of lecture centres, 22. Among the chief signs of progress recorded are (1) a great extension of university teaching in small towns, (2) a marked increase in the number of working men attending the lectures, (3) the arrangement of a number of successful and well-attended courses during the early summer months, (4) the establishment of 36 students' associations at various centres, and (5) the federation in two new districts of the various lecture centres. The students' associations are very valuable, inasmuch as "they encourage the students to undertake regular reading throughout the year in preparation for, or in continuation of, the courses of lectures." The federation movement is also extremely helpful. It enables the difficulty sometimes experienced in procuring lecturers to be more easily surmounted, and it fosters and stimulates local interest in the study undertaken. The committee regrets that a greater proportion of students do not present themselves for examination; but those who do go through the ordeal appear, on the whole, to come out very creditably. Scholarships are given to the writers of the best essays on a number of subjects connected with those studied during the course; and "among the successful essayists," we are told, "were two carpenters, two clerks, a fustian weaver, an artisan employed in a government dockyard, and three elementary teachers." In an examination recently held, those who were awarded certificates included "a national school-mistress, a young lawyer, a plumber, and a railway signalman." Again, we are informed that "a course of lectures on zoölogy recently given by an Oxford lecturer in Devonshire was attended by a student whose essays convinced the lecturer of her singular powers of accurate and original observation. She was encouraged by the lecturer to undertake a course of systematic study, and at his suggestion became a candidate in the examination for scholarships at Somerville Hall, where she was elected to the second scholarship."

— The latest information of the Russian expedition to Thibet, under the command of Col. Pevtsoff, is contained in the following letter from the mining engineer Bogdanovitch, published by the Russian newspaper the *Messenger of the Volga*, and republished in *Nature* of July 10: "Having happily passed through the winter at Nia, the expedition set out on April 24 to traverse the defile of Idjelik-Khanoum, and thus reach Thibet. Col. Pevtsoff had sent half his camels, carrying 23 bales with his col-

lections, to the banks of the Cherchen River, where they could recover their strength with the abundant pasture. These animals are intended to facilitate our return to Russia. Our baggage will be carried into Thibet on oxen hired for the purpose. We ourselves are riding thither on horseback, carrying with us the light portion of our effects. We left Nia with 30 horses. During the winter M. Roborovsky made an excursion to Cherchen, and I made one to the mountains of Karangon-Fag, south of Khoten. During my tour I met Grombchevsky, who came with me to Khoten in February, and thence returned for a short time to Nia. The health of all the members of the expedition is perfect; and during the winter we have received all our letters and papers from St. Petersburg, thanks to the good offices of M. Petrovsky, our consul at Kashgar. We shall send our collections to Russia through his agency." M. Grombchevsky has informed the military governor of the Syr-Darya district that the time of his journey has been extended until Jan. 15, 1891. His expedition has already traversed about 3,315 miles. M. Grombchevsky will pass the summer in exploring Thibet between Polon-Lhasa and Rudok.

—The occurrence of St. Elmo's fire at sea has been lately studied by Capt. Haltermann of Hamburg, who made examination of a number of ships' log-books for 1884 and 1885, reporting 156 cases in 800 months of observation. He finds, according to *Nature*, a greater number of cases in north than in south latitudes; and of 63 cases observed in the North Atlantic (the stormiest sea in winter), 49 occurred in the months November to April, and only 14 in the other half of the year. Of the total (156), only 27 were unaccompanied by thunder and lightning, and only 6 by precipitates of some kind. Snow and hail showers, with strong wind, seemed specially favorable. Of 133 cases accompanied by rain, there were only 15 without also thunder and lightning; while of 32 with hail, 18 were without thunder and lightning; and of 14 with snow, 12 without thunder and lightning. As to wind, there were instances with all degrees of intensity. The wind was in most cases (beyond 35° latitude) from equatorial direction; and this, with the commonly observed decrease of pressure, indicates that the cases mostly occurred in the front part of depressions. In 46 cases the barometer rose, and in 8 it was unaffected. In most cases the thermometer fell. Between the equator and 10° north latitude, 12 cases were observed, and not one in the corresponding region to the south, where the trade-wind generally prevails. In the region of the constantly blowing trade-wind, St. Elmo's fire is never met with. The western half of seas extending polewards from 30° latitude seems to afford the best conditions. On the whole, the occurrence of St. Elmo's fire may probably be ascribed to the same causes as give rise to thunder and lightning.

— The Lucayan Indians, who inhabited the islands now called the Bahamas, were the first Indians seen by Columbus. In less than twenty years this interesting people, numbering, according to the estimate of the conquerors, forty thousand persons, was wholly exterminated. The hammock was found among the Lucayans; and both the word and the thing were adopted by the Spaniards, through whom they were passed on to other nations. Various skulls have been recovered from caves in the Bahamas, and have been made the subject of a valuable paper by Mr. W. K. Brooks. This paper was read some time ago before the National Academy of Sciences, says *Nature* of July 10, and has now been reprinted as a separate memoir, with carefully executed illustrations. Columbus testifies that the Lucayans were "of good size, with large eyes, and broader foreheads than he had ever seen in any other race of men;" and Mr. Brooks says this agrees perfectly with the results he has reached, the most conspicuous characteristics of the skulls he has examined being the great breadth noted by Columbus, and the massiveness and solidity of the head. "We may therefore unhesitatingly decide," says Mr. Brooks, "that they are the remains of the people who inhabited the islands at the time of their discovery, and that these people were a well-marked type of that North American Indian race which was at that time distributed over the Bahama Islands, Hayti, and the greater part of Cuba. As these islands are only a few miles from the peninsula of Florida, this race must at some time have inhabited at least the south-eastern extremity of the continent; and it is therefore extremely interesting to note that the North American crania which exhibit the closest resemblance to those from the Bahama Islands have been obtained from Florida."

— Mr. James Bennett has, according to the *Colonies and India*, been commissioned by Lord Knutsford to proceed to Lagos, to make full inquiry into and report upon the mineral and vegetable resources of the colony with a view to their further development. Mr. Bennett is the inventor of a special process for extracting, by means of chemicals, pure rubber from the milk of the wild fig-tree, of which several species are to be found in Lagos and the neighborhood, and it seems likely that considerable advantage will accrue to the colony from his visit. Mr. Bennett will devote particular attention to such products as rubber, gums, fibres, and minerals, in which it is thought that the present trade of the colony may be largely increased, or which are considered likely to become subjects of local manufacture.

— The *London Times* gives some details of the new expedition to the north pole, for which the Norwegian National Assembly voted 200,000 kroner on June 30, and which will be under the charge of M. Nansen. Hitherto, with one possible exception, all attempts to reach the north pole have been made in defiance of the obstacles of Nature. It has been an open campaign between the endurance of man and the icy barrier of the Arctic Seas, in which Nature has always been triumphant. On this occasion a systematic and well-organized attempt will be made to ascertain if Nature herself has not supplied a means of solving the difficulty, and if there is not, after all, a possibility of reaching the north pole by utilizing certain natural facilities in these frozen seas of which all earlier explorers were ignorant. The circumstances on which these new hopes are founded may be thus summarized. The "Jeannette" expedition of 1879–81, and the loss of that vessel, seemed to sound the knell of all expeditions to reach the pole by Bering Straits; but in the end the results of that effort are shown to have been more satisfactory and auspicious than any of the officers of the "Jeannette" could have hoped for, when, with extreme difficulty, they succeeded in reaching Siberia across the ice from their wrecked vessel. In June, 1884, exactly three years after the "Jeannette" sank, there were found near Julianshaab, in Greenland, several articles which had belonged to the "Jeannette," and been abandoned at the time of its wreck by the crew, and which had been carried to the coast of Greenland from the opposite side of the Polar Sea on a piece of ice. This fact at once aroused curiosity as to how it accomplished the journey across the Arctic Ocean, and as to what unknown current had borne the message from Bering Straits to Greenland. However these objects reached Julianshaab, they could not have come in an eastern direction, through Smith's Sound, for the only current which reaches Julianshaab is that from the eastern coast of Greenland *via* Cape Farewell and the north. Nor is there much probability that they were borne in a western direction from the place where the "Jeannette" sank, for all the currents round Nova Zembla, Franz-Josef Land; and Spitzbergen are known, and it seems impossible for the ice bearing the relics of the unfortunate "Jeannette" to have traversed the intervening distance in the space of three years, even if it were possible at all. There remains only the alternative, that there is a comparatively short and direct route across the Arctic Ocean by way of the north pole, and that Nature herself has supplied a means of communication, however uncertain, across it. Increased significance to the discovery of the "Jeannette" relics in 1884 was given by the identification in 1886 of bows found on the coast of Greenland with those by the Eskimo in the vicinity of Bering Straits, at Port Clarence, Norton Sound, and the mouth of the Yukon River. M. Nansen's expedition will endeavor to realize these hopes of a direct route across the apex of the Arctic Ocean. A specially constructed boat of one hundred and seventy tons will be built, and provisions and fuel taken for five years, although it is hoped that two will suffice. The expedition will consist of ten or twelve men, and M. Nansen proposes to leave Norway in February, 1892.

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Communications will be welcomed from any quarter. Abstracts of scientific papers are solicited, and twenty copies of the issue containing such will be mailed the author on request in advance. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

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CONTENTS:

THE DEGENERATION OF THE TECHNICAL SOCIETIES.

THERE is much current discussion of the present condition of the great technical societies in the United States. The older members seem to be somewhat apprehensive lest the fruits of their great labor and zeal in the earlier days, in the formation, especially, of the national societies of engineers, may be sooner or later wholly lost. The discussions at recent conventions of the Society of Civil Engineers, the most venerable of them all, and the criticisms of our exchanges among the technical journals most interested in its work, lead us to suppose that there is a question whether it does not require some such agitation and revolutionary reconstruction as brought it out of its stupor and threatened decadence fifteen years or more ago, to prevent its utter evanescence now. It is said by the agitators, that the number and quality of its papers, and its influence and growth as a national association, are falling off constantly; that local societies are absorbing those who should enter it, and who should form its material of the coming generation, so generally, that it must apparently, unless this retrograde movement be promptly checked, soon lose its old pre-eminence. It is said by the critics that it no longer holds interesting sessions at its central office; nor does it get together, except by robbing its regular meetings, either much or valuable material for its annual conventions. It is said that a few of the older members only, "run" the society; and that the great men of the profession, and the promising young men, do not come in as they should, either submitting papers or taking part in the discussions.

Of the Mining Engineers' Society we hear little of such criticism. But it is sometimes suggested that it is by no means a representative or a professional association; that it includes whoever chooses to join; and that those who thus choose are largely non-professionals, or, at least, that the semi-professionals form a large proportion of its body of members, as well as associates. The criticism made of its publications is, that they often include the purely mercantile rather than the professional and scientific element, and that shop and advertisement are too often mixed with the more instructive and original papers.

Of the mechanical engineers we note the observation, by its special constituency among the journals, that while its growth seems to be healthy and steady, its finances well managed, and its conventions well attended, the reader of its "Transactions" misses the names and the papers of a number of the able men who were in its earlier days regular contributors; while the tone of the discussions has deteriorated, and courtesy and good breeding are sometimes forgotten by too youthful or too earnest disputants.

Of the electrical engineers are said, so far as we have observed, only words of praise; though the remark is made that its membership seems to be drawn from among the electricians rather than from the engineers of the great body of electrical engineers who are its natural recruits. Many and excellent papers are presented relating to the dynamo and its physics; few relating to the dynamo as a piece of engineering, or to the designing and construction of stations, of engines and boilers fitted to this department of work, or the engineering of the distribution of electrical energy.

We presume that in many respects these criticisms are simply the outcome of that spirit of fault-finding which is rife in all young societies and among the "fresh" members, who are more ambitious and earnest than wise or just; but there may be some reason behind it all, and the questions are often asked, How may these societies be made more truly national? How may they be given a more representative character? How may the distinguished and experienced members of each be brought into view, and induced to work with and for their continued growth and improvement? The formation of committees of each of the societies to confer together, and to seek some way in which all can be brought into closer relations, and of other committees looking to the absorption of local societies as chapters of the national body, give color to the suspicion that there may be some cause of criticism, and some opportunity of improvement.

If we might make a suggestion, it would be about as follows: see that the presiding officer and the members of the boards of management are elected invariably from among the oldest and most distinguished of available candidates, and that Benjamin Franklin's principle — "No American citizen has a right to seek office; but no true American citizen will refuse to accept office, when called by his fellows to take a position of honor and responsibility" — be paraphrased, and adapted to the case; see that the wise, experienced, able, and honest members are encouraged to present the best fruits of their labors; and especially see that they are treated respectfully, and fairly and kindly, in all discussions. See the "Transactions" carefully placed in the great libraries, and that the papers going before any meeting are given in advance to the representatives of the technical press; see, also, with especial care, that these journals have capable and discreet representatives at the conventions and meetings; and insure, if possible, with still greater care, their treatment with all courtesy, otherwise no complaint of discourtesy will hold against them or their principals. Let the presiding officer and the secretary see that the slightest rudeness or discourtesy, the least variation from the rules of good manners and good breeding, is instantly reprimanded, and the offender properly dealt with; making it the

habit, as well as the principle, that all discussion must be conducted fairly and kindly, and in a proper spirit, whoever may be on either side the controversy. Make all members of the profession welcome at headquarters; and let them see that they cannot, without injury to their own interests, defer becoming members of so representative and powerful a body of their comrades. We think the observing of these few simple principles will insure prosperity, without changes of constitution.

HEALTH MATTERS.

Chemical Salts developed in Living Organisms.

A MEMOIR by Mr. Robert Irvine and Dr. Sims Woodhead, entitled "Secretion of Carbonate of Lime by Animals," recently published in the "Proceedings of the Royal Society of Edinburgh," deals with the interesting question of the assimilation of food and the development of structures partially composed of a definite proportion of insoluble chemical salts. Thus, hens supplied with sulphate of lime, but no other lime salt, produce well-formed egg-shells composed of carbonate of lime. The process of shell-formation in the crab appears to differ chemically from egg-shell development in the hen. Sulphate of lime is not assimilated in the same manner, so that crabs which throw off their shells in artificial sea water in which sulphate of lime as well as chloride of sodium are present, but from which chloride of calcium is excluded, do not form a new exo-skeleton of carbonate of lime. As soon as chloride of calcium is added, although the sulphate be withheld, shell-formation may go on. The authors of the paper minutely describe the share which epithelial and other cells play in secreting, or causing the deposit of, chemical salts in shells and in bone. The histological and chemical processes differ considerably in bone, in egg-shells, in the shells of crustacea, and in the "mantle" of mollusca.

The Use of Leeches in Bacteriology.

Dr. Pasternatski has found that a very convenient method for collecting and preserving for cultivation the spirillum of relapsing-fever is to use leeches. If the leeches are kept in a cold place, the spirilla they contain preserve their vitality for a considerable period, much longer than they do when kept in capillary or other glass tubes. When exposed for some time to a temperature of from 27° C. to 30° C., the spirilla were found to undergo transformation into other forms.

Lead-Poisoning.

Investigations made this year appear to show, as reported by a contemporary, that the lead-miner does not really suffer in health more than any other worker under ground, as the ore is not in a condition to be absorbed by the body, but that lead-smelters and all engaged in the manufacture of lead, particularly white lead, run a very great risk of being contaminated sooner or later. It also appears that at Tyne-side, the chief centre of the English lead trade, there is one type of ailment which is rarely seen elsewhere, attacking those who have been engaged in the work only a few months, or even weeks, — a fatal disease, the principal victims being girls of from seventeen to twenty-three years of age. They rapidly display symptons of this form of toxemia in the way of severe headache, followed by colic and blindness: and unless they speedily leave work for a considerable period of time, and undergo most careful treatment, the fatal result is rapidly ushered in, usually with epileptiform convulsions and coma. It is remarkable, however, that but little trace of lead is found in their bodies after death, perhaps not more than a few grains in the internal organs, after they have been subjected to the most complete and exhaustive examination.

LETTERS TO THE EDITOR.

Osteological Notes.

VIRGIL never wrote a more truthful or more appropriate line than the one in which he says,

"Felix qui potuit rerum cognoscere causas."

How is the fact to be explained, that, with the exception of a single family, the marsupials have no patella, or, at the best, a very rudimentary one, when all the other orders of the *Mammalia*, as well as certain of the reptiles and birds before them, are thus supplied?

The patella is the largest of the sesamoid bones, and, like the other sesamoids, is developed in the course of a muscle or tendon, wherever marked friction occurs, or where protection or increased leverage is demanded. Placed on the anterior surface of the knee joint in the conjoined tendon of the four extensors of the leg (*quadriceps extensor*), this bone is of a triangular form, its base being turned upwards to receive the above tendon, and its apex downwards to be united by the strong ligament to the tubercle of the tibia.

John Bell says, "The patella is manifestly useful chiefly as a lever, gliding upon the fore-part of the thigh-bone, upon the smooth surface which is betwixt the condyles. The projection of this bone upon the knee removes the acting force from the centre of motion so as to increase the power; and it is beautifully contrived, that while the knee is bent, and the muscles at rest, as in sitting, the patella sinks down concealed into a hollow of the knee. When the muscles begin to act, the patella begins to rise from this hollow; in proportion as they contract, they lose their strength, but the patella, gradually rising, increases the power, and, when the contraction is nearly perfect, the patella has risen to the summit of the knee; so that the rising of the patella raises the mechanical power of the joint in exact proportion as the contraction expands the living contractible power of the muscles."

In the marsupials the patella may be entirely absent, or its place may be supplied by a cartilaginous disk, with occasionally slight specks of bony matter intermingled, or, in some cases, by a simple broadened expansion of the tendon. In only one family, the bandicoots (*Peramelidæ*), is this bone fully developed, and the groove in the femur, for its action, well marked. In the phalangers (*Phalangistidæ*), as also in the native cats (*Dasyuridæ*), the groove is broad and shallow, and the patella but slightly developed, consisting of a moderate thickening of the tendon *quadriceps extensor*.

In the flying phalangers (*Petaurists*), in the native bear (*Phascolarctos cenoreus*), and in the wombat (*Phascolomys*), as well as in the banded ant-eater (*Myrmecobius*), the anterior distal surface of the femur is almost plane from side to side, exhibiting no depression for a patella, which does not exist. In the opossums (*Didelphidæ*) there is a slight thickening of the tendon. In the typical kangaroo (*Macropus*), as well as in the kangaroo rat (*Hypsiprymnus*), the muscular tendon is fairly developed, and the femoral groove correspondingly well marked. Owen says that he has found a small patella in *Macropus bennetti*.

In searching for a solution of the problem thus presented, the low organization of the order of the *Marsupialia* must be especially recognized. They have close affinities with the reptiles and birds (*Sauropsida*), in most of which no patella exists. The presence of this bone in certain lizards among the reptiles, and in certain birds, offers no greater anomaly than its existence solely in one family of the marsupials. Then, again, we find similar provisions made for its absence in the reptiles, birds, and marsupials; viz., a prolongation and modification of that tubercle of the tibia which thus supplies increased leverage.

Moreover, there is nothing observable in the anatomy or in the habits of the bandicoots that would lead us to suppose that they specially needed a normally constructed patella. They are small, rat-like animals, about eighteen inches in length, having a singular gait, which is made up of jumping and running; and they live among stony ridges in the eastern and south-eastern portions of Australia. They are allied in their food to the placental *Insectivora*.

Cope, in his "Hard Parts of the Mammalia," says, "The existence of tibia and fibula of subequal size gave rise to two distal articular surfaces of the femur. The constant use of these in flexion and extension gave them the convexity which they possess in the *Mammalia*, — a process already commenced in the *Reptilia*. The strong tendon of the rectus muscles passing over the anterior face of the extremity gave rise to the rotular groove. This became better defined and more important after the development in placental mammals of a sesamoid bone or patella in the tendon."

The phylogeny of the marsupials is as yet closely surrounded by many doubts, which, however, paleontology is slowly but surely clearing away. It is probable that the earliest mammalian remains so far discovered are marsupial; that is to say, so far as brain and reproductive development are concerned. It is highly probable, also, that the relation between the marsupials and the still lower organized monotremes is a comparatively near one, although, as Marsh says, "we have as yet no hint of the path by which these two groups became separated from the inferior vertebrates." That they did become separated, and that the marsupials at least inherited the characters, more or less modified, which marked their reptilian ancestors, among which may be enumerated the entire absence or incomplete condition of a rotula or patella, there is much reason to suppose. D. D. SLADE.

Cambridge, Mass., July 17.

One of Dr. Hann's Teachings.

HOWEVER much or little the Sonnblick temperature observations of Dr. Julius Hann are going to teach us about the nature and cause of cyclones, I think we may at least profit by the example which he affords us, in the spirit with which he has conducted his discussions of meteorological topics with those who differed from him. In the valuable papers which Professor Abbe translated for the "Smithsonian Report of 1877," Dr. Hann has frequent occasion to reply to his critics, Capt. Hoffmeyer, Reye, and others; and he does so not only in a tone of courtesy, such as a true gentleman would naturally employ, but also with an evident desire, in the interests of science, and quite regardless of personal pride in his own consistency, to reconcile conflicting views as far as possible. Is not this the best way in which to ascertain and establish the truth? RESEARCH.

The Aurora.

IN the course of an extended research in regard to the relation of the aurora to magnetic and solar conditions, in which I have been engaged for several years, the question as to whether atmospheric movements are affected has been considered. Incidentally the matter of tornadoes, touched upon by Professor Hazen in the last of his articles upon that subject thus far published, has been taken into the account. As his table on p. 30 of *Science* for July 18 appears to indicate, at least for the years for which the more complete reports are to be had, a relation of some sort to a disturbed condition of the sun appears to exist. His method of attempting to show in detail the "specific influence of spots" is not, however, quite complete. For instance: the glowing eruptions known as the *faculæ* are far more intimately related to magnetic storms, and presumably other phenomena, than are the spots. It is not my purpose to enter upon the discussion in detail at present. Tables are in existence, and in process of verification, which may one day be published if found complete after searching tests to which they are being submitted. Enough has been learned to warrant the positive affirmation that this subject has not yet been exhausted. Certainly there is room for improvement in knowledge of the causes of sudden intensification of storm energy. M. A. VEEDER.

Lyons, N.Y., July 21.

BOOK-REVIEWS.

Contributions to American Educational History, Nos. 8 and 9. Ed. by HERBERT B. ADAMS. Washington, Bureau of Education. 8°.

THE first of these pamphlets is a "History of Education in Alabama," by Willis G. Clark, and is mainly devoted to the University of Alabama and other collegiate institutions. The history of the State University is recounted at tedious length, and with a particularity out of all proportion to its importance. The other institutions, both colleges and academies, are more briefly dealt with, while the public schools are dismissed with a very short notice indeed. The system of public education is of very recent growth; and even now, as Mr. Clark states, the schoolhouses are altogether insufficient to accommodate the pupils. What the real quality of the various schools is, it is impossible from this pamphlet to clearly make out. In treating of the University of Alabama, for instance, Mr. Clark has a great deal to say about the finances of the institution, the lives of the various professors, the quarrels between professors and students, and other matters of minor importance; but what the course of study there actually is, how strictly it is pursued, and how the education furnished there compares with that given by other universities, Mr. Clark does not sufficiently inform us. Yet these are just the things that readers most wish to know. As far as it goes, however, his work seems to have been carefully and conscientiously done.

The other pamphlet in our hands is "The History of Federal and State Aid to Higher Education in the United States," by Frank W. Blackmar. It begins by recounting what the general government has done in this direction, partly by land grants to the States for educational purposes, and partly by the establishment and maintenance of the Smithsonian Institution, the Naval and Military Academies, the Library of Congress, and other institutions of an educational character. Then, taking up the States in detail, it shows what each of them has done in founding and maintaining colleges and universities, and also agricultural and technical schools. Mr. Blackmar has used much care and diligence in collecting his facts, and his work will be useful for reference; but it cannot be called a readable book. It is, in short, a mere catalogue of facts, set forth in a dry and technical style; and it does seem as if the subject might have been treated in a more interesting manner.

Reflections on the Motive Power of Heat and on Machines fitted to develop that Power. By N. L. S. CARNOT. Tr. by R. H. Thurston. New York, Wiley. 12°. $2.

BOTH publisher and author, in the case of this book, disclaim any expectation of reaping large pecuniary reward. Yet there are many reasons why this first English translation of a scientific work, that lay buried and unknown for many years till Sir W. Thomson chanced on it, and found in it the true explanation of the mode of working of the steam-engine, should have a place in every library where such epoch-marking books are to be expected.

The Carnot whose contributions to physical science are made public in this volume was born in the smaller palace of Luxembourg, June 1, 1796. His father was prominent in the political life of France during the close of the last century, and his grandnephew of the same name — Sadi Carnot — is now president of the French republic. He early manifested an interest in mechanics, which induced his father to give a scientific bent to his son's education. Naturally, in the absence of the polytechnic schools of the present day, this education was obtained in the military schools. As a result, Sadi Carnot, at the age of twenty-three, found himself in Paris on a long furlough, which gave him the leisure and opportunities for study which he had earnestly desired.

He diligently followed the course of the College of France and of the Sorbonne, of the École des Mines, of the Museum, and of the Bibliothèque. His interest in mechanics led him to the workshops, and in the fine arts to the study of painting and music.

In 1826 a return to active military duties was necessitated; but two years later, Sadi Carnot laid aside his uniform, that he might be free.

It was before this time, in 1824, that the paper on the motive power of heat was published. He had noticed how little advance had been made in steam-engines, and that such advances as were accomplished had come largely as the result of accident. It must be remembered that at that time the conservation of energy was unknown. This Carnot first suspected and then established, so far as the conversion of heat into work was concerned. Yet the scientific atmosphere of his time was so saturated with the idea that heat was material, that he made no use of this conversion of heat into work in his typical heat-engine, now so well known as Carnot's engine. He allowed the prevailing errors to dominate him in this wonderful elucidation of the essentials of an engine that shall give work for heat. Not only did he show the necessity of having a hot body and a cold body for the working of a

heat-engine, but he showed the limitations to the efficiency of such an engine. and the directions in which improvement might be looked for. As a result, we have the triple-expansion engines of the ocean greyhounds.

But all this work was far in advance of the thought of his time, and was destined to remain unappreciated for years after the author's death, which took place Aug. 24, 1832.

AMONG THE PUBLISHERS.

A TIMELY article on "A Tornado's Power," by William A. Eddy, in *Harper's Weekly* for July 26, gives a vivid description of the destructive tornado of July 13, near St. Paul, Minn. The article is accompanied by four illustrations.

— In an article in the August *Lippincott*, on "Milk-Legislation," R. M. Elfreth presents the European legislative methods for preserving the purity of this important article of diet, and suggests to our own legislators certain wise provisions. Charles Morris contributes a sketch of the Philadelphia Academy of Natural Sciences.

— Mr. Edward Atkinson is to publish in *The Popular Science Monthly* for August and September two extended and important articles on the revision of the tariff, under the title "Common Sense applied to the Tariff Question." Like other articles in the field of political science which appear in the monthly, these papers will discuss the subject with a refreshing disregard of partisan advantage. In the first of these, which will open the August number, he shows the incompetence of American legislators and government officers in dealing with financial questions, and, without taking extreme ground, goes on to point out weighty business considerations which should determine the direction of tariff reform.

— A dozen articles are included in the *Westminster Review* for July, issued in this country, by authority of the English publishers, by the Leonard Scott Publication Company, New York. A. Amy Bulley writes on "The Political Evolution of Women;" James W. Davis discusses the Sunday opening of public libraries, art-galleries, and museums; William Trant writes on "Prairie Philosophy," presenting a picture of social and daily life in the great Canadian North-west; Professor Andrew Gray writes on "Technical Education in Wales;" R. Seymour Long reviews the civil struggle in England in the seventeenth century, in a paper entitled "The Case for the Commonwealth;" E. F. Hannigan contributes an essay on "Genius and Moral Responsibility;" Janet E. Runtz Rees relates the experience of a bread-winner in an article on "Wage Value in America;" G. S. Godkin writes on "Old Italy *versus* Young Italy;" Theal's "History of South Africa," and some of the most important of recent novels, are reviewed; an anonymous writer discusses the rights of labor; and the usual monthly review of home affairs treats of the latest developments in English political life.

— Edward Marston, the veteran London publisher, writing in the August *Scribner* about "How Stanley wrote his Book," gives the following particulars of the materials from which it was made: "Mr. Stanley's memory of names, persons, and events, is quite marvellous, but in the compilation of his book he by no means trusted to his memory. His constant habit was to carry a small note-book, six by three inches, in his side-pocket. In this he pencilled notes constantly and at every resting-place. Of these note-books he has shown me six, of about one hundred pages each, closely packed with pencil memoranda. These notes, at times of longer leisure, were expanded into six larger volumes, of about two hundred pages each, of very minute and clear writing in ink. In addition to these field note-books and diaries, there are two large quarto volumes, filled from cover to cover with calculations of astronomical observations," etc. He also tells this story of Stanley while at work on his great book: "Sali, the black boy who travelled with him throughout his long and perilous expedition, is a youth of some resource. Until this terrible book had got into his master's brain, he had been accustomed to free access to him at all hours; but now things were different. Every time he approached the den, the least thing he expected was that the ink-stand would be thrown at his head. He no longer ventured therein. One day he originated a new way of saving his head: he had a telegram to deliver, so he ingeniously fixed it on the end of a long bamboo, and, getting the door just ajar, he poked it into the room, and bolted."

— A copiously illustrated account of the missions and mission Indians of California will be contributed to the August *Popular Science Monthly* by Henry W. Henshaw. He represents the rule of the priests as more conducive to the numerical growth of the Church and the profit of the missions than to the welfare of the Indians. A picture of Ramona and her children standing at the door of her hut is one of the illustrations. Mr. Bernard Hollander of London will contribute to the same number an illustrated paper on "Centres of Ideation in the Brain." It will show how the experiments of modern physiologists support some of the observations of the early phrenologists, though by no means indorsing all that the name "phrenology" implies. There will also be an article on "Ancient and Modern Ideas of Hell," by Frederik A. Fernald. It will doubtless prove very seasonable just now, when the air is full of the proposed revision of certain Presbyterian doctrines. Other articles are "Thunder-Storms," by Robert H. Scott; "A Queer Pet," by Miss E. W. Bellamy; and "The Uses of Animal Color," by Edward B. Poulton.

—The last two issues of the American Historical Association contain some papers of interest. The January number is partly occupied by the secretary's report and the list of members, which show the society to be in a flourishing condition, the number of members having increased, since the formation of the society six years ago, from forty to six hundred and twenty. The same number contains a paper by President Adams of Cornell, on "Recent Historical Work in the Colleges and Universities of Europe and America," which shows clearly, that, notwithstanding the improvements of the last few years, we are still in the rear of other nations in this department of study. It seems to us, however, that President Adams overrates the usefulness of the German seminary courses, which are mainly devoted to the mere study of facts; and that what we need are courses like those at Oxford and Cambridge, in which special attention is given to the formation of a true historical judgment as to the significance of events. The study of historical facts is very simple, as is proved by the ease with which young men learn it; but the formation of a judgment that can properly interpret history requires a far more elaborate culture, and ought, therefore, to be the chief object of attention. The April number of the association's papers is entirely devoted to a sketch of the origin of the national scientific and educational institutions of the United States, written by Dr. G. Brown Goode of the Smithsonian Institution. The author begins with an account of the formation of the American Philosophical Society at Philadelphia in 1769 and the American Academy of Arts and Sciences at Boston in 1780, both of which are still in existence. He then recounts the efforts of Washington, Joel Barlow, and others, to found a national university at the national capital,—efforts that have often been renewed since, though as yet without success. Special attention is given to the organization of the Coast and Geological Surveys, and some account is given of the earliest exploring expeditions. The foundation of the Smithsonian Institution is of course described, and particular attention is devoted to the organization and development of the weather service. Dr. Goode writes with an enthusiasm that makes his paper interesting, and we commend it especially to scientific readers. The papers of the association are published quarterly at one dollar each, by G. P. Putnam's Sons, New York.

— The American Academy of Political and Social Science was organized last December in Philadelphia, and now gives to the public the first number of its *Annals*. We wish we could say that the papers contained in it are superior to others on similar subjects that have appeared elsewhere; but they have the same superficiality that characterizes so much of American thought and scholarship. The best paper in the number is the opening one, by J. G. Bourinot, on "Canada and the United States." The author compares the government of his own country with ours, and, while admitting the superiority of ours on some points, shows

that we might copy some things from Canada with benefit to ourselves. In particular, he shows the advantages of a responsible ministry, which is the leader of legislation as well as of administration. Mr. Simon N. Patten has a curious paper on "Decay of Local Government in America," in which he contends that our State and local governments have "a mere nominal existence," which we take leave to say is absurd. The next article, by. J. B. Clark, is on "The Law of Wages and Interest." It is based on Jevons's theory of final utility, but does not seem to us to shed any new light upon the problem. Mr. F. H. Giddings discusses the province of sociology, but fails to prove even the existence of such a science, or to state any of its principles. Following this paper are some tables by Leo S. Rowe, giving the courses of study in public law and economics in the German universities, and also an account by Jane J. Wetherell of a new kind of railway passenger tariff recently adopted in Hungary. It is impossible for us to describe it here, and its success is still problematical; but railroad managers will doubtless take an interest in reading about it. A variety of notes and book-reviews fill out the number. The *Annals* is published for the academy by A. L. Hummel of Philadelphia at one dollar a number.

—The July number of the *Nineteenth Century*, issued in this country, under authority of the English publishers, by the Leonard Scott Publication Company, New York, begins the twenty-eighth volume, and is a brilliant number. Sir J. Pope Hennessy opens it with a brief paper entitled "The African Bubble," in which he briefly discusses the relative positions of England and Africa on this important question engaging the attention of the world. Professor Huxley takes the new theological book, "Lux Mundi," as a text for the scientific interpretation of Scripture in an article entitled "Lux Mundi and Science." He directs his special attention to the story of the Flood, and his criticisms will doubtless have wide reading. T. W. Russell, M.P., writes on "Compensation or Confiscation," in which he takes up the subject of the political treatment of the temperance question in Parliament. Mlle. Blaze de Bury has an article on "The French Opera," in which she traces its history from its beginnings to the present time. The editor, Mr. Knowles, raises the question of memorials in Westminster Abbey, and explains, with the aid of two plans, how much room there is still unoccupied. The King of Sweden concludes his memoir of Charles XII., dealing with the later years of the hero's life. Henry Snow discusses one of the most important questions of the day in a paper on "The Increase of Cancer: its Probable Cause." An article on "Official Polytheism in China," by A. C. Lyall, treats of the official religion of China, and the extent to which it permeates official society. Frederick Greenwood, the late editor of the *Pall Mall Gazette*, and one of the foremost of English journalists, writes on "The Press and Government," and shows how intimate the connection between the two sometimes is. Oscar Wilde contributes the first part of a dialogue entitled "The True Function and Value of Criticism, with Some Remarks on the Importance of doing Nothing." Mr. Wilde expounds the nature of criticism as he understands it, in a thoroughly characteristic manner. Sergeant Arthur V. Palmer tells what he saw at Tel-el-Kebir, which is interesting as being the testimony of an eye-witness. Earl Grey discusses the Irish Purchase Bill. J. L. Mahon writes on "The Crisis in the Post-Office," treating of conditions which are not without importance in determining, in the future, the relations of trades-unions to government work.

—*The Chautauquan* for August presents, among other matter, "The Condition of American Agriculture," by Manly Miles, M.D.; "A Sixteenth Century Garden," by Ferdinand Cohn; "Country Life in Ireland," by J. P. Mahaffy, M.A.; "Keeping Well in Summer," by Felix L. Oswald, M.D.; "The Minor Lakes of the Northwest," by Horace B. Hudson; "Women Physicians in Germany," by A. Von Strande; "Economical Grocery Buying," by Christine Terhune Herrick; "Brain-Workers' Recreation in Flowers," by Sarah K. Bolton; "Out-door Life at Wellesley," by Louise Palmer Vincent; and "Children's Wit," by Margaret J. Preston.

Publications received at Editor's Office, June 30–July 19.

ABEL, Mrs. Mary Hinman. Practical Sanitary and Economic Cooking adapted to Persons of Moderate and Small Means. (Lomb Prize Essay.) Rochester, N.Y., Amer. Pub. Health Assoc. 190 p. 12°.

ANNALS of the American Academy of Political and Social Science. Vol. I. No. 1. July, 1890. *q.* Philadelphia, A. L. Hummel. 164 p. 8°. $3 per year; with supplements, $5.

BAKER, A. L. Elliptic Functions. New York, Wiley. 118 p. 8°. $1.50.

BLACKMAR, F. W. The History of Federal and State Aid to Higher Education in the United States. Washington, Government. 343 p. 8°.

CHAMBERS, G. F. A Handbook of Descriptive and Practical Astronomy. III. The Starry Heavens. 4th ed. Oxford, Clarendon Pr. 384 p. 8°. (New York, Macmillan, $3.50.)

CHILDS, G. W. Recollections of General Grant. Philadelphia, Collins Printing House. 104 p. 48°.

CHISHOLM, G. G., and LEETE, C. H. Longmans' School Geography for North America. New York, Longmans, Green, & Co. 384 p. 12°. $1.25.

CLARK, W. G. History of Education in Alabama, 1702–1889. Washington, Government. 281 p. 8°.

DAVIS, E. W. An Introduction to the Logic of Algebra. New York, Wiley. 119 p. 8°. $1.50.

GURNEY, E. H. Reference Handbook for Readers, Students, and Teachers of English History. Boston, Ginn. 125 p. 12°. 85 cents.

HYDE, E. W. The Directional Calculus, based upon the Methods of Hermann Grassmann. Boston Ginn. 247 p. 8°. $2.15.

MYEROVITCH, M. The Origin of Polar Motion. Chicago, Rosenberg Bros., Pr. 32 p. 8°.

NEW JERSEY. Final Report of the State Geologist. 1889. Vol. II. Part I. Trenton, J. L. Murphy Publ. Co. 642 p. 8°.

PICKARD, J. L. School Supervision. New York, Appleton. 175 p. 12°. $1.

RAYMOND, M. G. Les Grands Centres d'Action de l'Atmosphère. Paris, Gauthier-Villars. 84 p. 12°.

TEXAS, First Annual Report of the Geological Survey of, 1889. Austin, State. 410 p. 4°.

U. S. GEOGRAPHICAL SURVEYS West of the One Hundredth Meridian. Vol. I. Geographical Report, 1889. Washington, Government. 780 p. 4°.

WELLS, E. R., jun., and KELLY, J. W. English-Eskimo and Eskimo-English Vocabularies. Washington, Government. 72 p. 8°.

—Chauncey M Depew has received an autograph letter from the Prince of Wales, acknowledging the receipt of his "Orations and After-Dinner Speeches," recently published by the Cassell Publishing Company, New York. The prince expresses his thanks warmly, and indicates his belief that a perusal of the book will assist him greatly in his work of preparing the numerous addresses he is called upon to deliver on ceremonial occasions.

—The fifty-eighth volume of the *Contemporary Review* begins with the July number, issued in this country, under authority of the English publishers, by the Leonard Scott Publication Company, New York. Mr. Bellamy opens the number with an article entitled "What Nationalism means," in which, while answering some of his most recent critics, he re defines his position, and makes his theories clearer than he has done before. Gabriel Monod discusses recent events in France in a paper entitled "On French Affairs," in which he gives large space to the relations of France and Germany. Rev. Dr. Waugh contributes an exhaustive paper on "Child-Life Insurance," dealing with both the practical and theoretical parts of the question. Graham Sandberg has an important paper on "A Journey to the Capital of Thibet," based on the notes of the celebrated Hindoo scholar Chandra Das. This narrative is now made public for the first time, having been suppressed for political reasons. It tells of a part of the world never before described by a European. The article is accompanied with a sketch-map of the city of Lhasa, the capital of Thibet. Dr. Thomas Dolan writes on "M. Pasteur and Hydrophobia," devoting himself to an examination of the practical work of the famous Frenchman in this field. Sidney Webb contributes a thoughtful paper on "The Reform of the Poor Law," treating of the latest attempts to ameliorate the condition of the working-classes. Joseph Pennell, the well-known artist, tells of a new profession wanting professors, in a paper on "The Possibilities of Illustration." Professor John Rae continues the discussion of a betterment tax, which has lately been prominent in this review. The number closes with two brief papers on "Compensation for Licenses," — one by E. N. Buxton, and the other by Andrew Johnston.

—The forty-eighth volume of the new series of the *Fortnightly Review* begins with the July number, just issued by the Leonard Scott Publication Company, New York, under authority of the English publishers. It opens with a symposium on "The Actor-Managers," by Henry Arthur Jones and Herbert Beerbohm Tree. This subject has recently attracted much attention both here and abroad, and the present papers form an important contribution to the controversy. E. B. Lanin writes on "Russian Prisons: The Simple Truth," and draws a very dark picture of the realities of Russian prison-life. George Moore writes on "Meissonier and the Salon Julian," describing the origin of the Salon and the recent rupture between it and the artists. Edmund Gosse writes on "The Protection of American Literature," basing his paper on the late discussion in Congress on the copyright bill. J. Scott Keltie contributes a *résumé* of Mr. Stanley's expedition, dealing with its conduct and the results as viewed from a scientific standpoint. Madame James Darmesteter writes on "The Workmen of Paris." This paper, of which the first portion is now published, compares the condition of the Parisian workmen in the fourteenth and nineteenth centuries, and aims to portray a picture of actual life. John Addington Symonds presents some passages of Italian travel in an article entitled "Among the Euganean Hills." Three important papers on Germany and England in Africa, presenting as many phases of the subject, close the number. The writers are H. H. Johnston, V. Lovett Cameron, and Ernest W. Beckett. These papers are doubtless the most important contributions yet made to this subject, and are invaluable to those who would correctly understand the momentous events now transpiring in the Dark Continent.

Wants.

Any person seeking a position for which he is qualified by his scientific attainments, or any person seeking some one to fill a position of this character, be it that of a teacher of science, chemist, draughtsman, or what not, may have the 'Want' inserted under this head FREE OF COST, *if he satisfies the publisher of the suitable character of his application. Any person seeking information on any scientific question, the address of any scientific man, or who can in any way use this column for a purpose consonant with the nature of the paper, is cordially invited to do so.*

WANTED.—A Mining Engineer of standing and experience. One having had practical experience in Coal Mining and the manufacture of Coke preferred. Address A., care "SCIENCE."

CHEMIST.—A Harvard Graduate and Specialist in Chemistry desires a position with some manufacturing industry, or with a practical chemist. He would make an engagement to take charge of a laboratory and lecture on Chemistry. He has had large experience in the laboratory and school-room, and can give the best of references. Address J., Harvard College, Cambridge, Mass.

WANTED.—A Lady Teacher, at present teaching in England, with 12 years of very successful experience in primary work, desires a similar position in America. An appointment in the State of Ohio, or the City of New York, preferred. Excellent references, etc. Address in July or August, L. DUNCAN, Poste Restante, Stainland, Halifax, England.

WANTED.—The latest and most reliable authorities on the Occurrence, Analysis, and Practical Uses of Native Hydro-Carbons, such as Bitumen, Asphaltum, Mineral Wax, etc. Address DR. J. E. TALMAGE, Box 1,047, Salt Lake City, Utah.

WANTED.—A position as Teacher of Natural Sciences; will teach German or English branches if desired. Address Box 235, Charlestown, N. H.

A ZOOLOGIST, acquainted with the United States, graduate (Ph.D. Freiburg, B.Sc. of an English university) of many years' standing; late Fellow of an English college; late assistant to a German university, professor of Comp. Anatomy; many years a student at two German universities; pupil of Huxley, Kölliker, Semper, Wiedersheim and Weismann; author of many well-known memoirs on Comp. Anatomy and Embryology; thoroughly conversant with all branches of the subject; fond of teaching, with good testimonials, seeks a Professorship. Address "MORPHOLOGIST," Office of SCIENCE. Other information and a few testimonials can be seen at the Office of SCIENCE.

AN EXPERIENCED TEACHER desires to hear of a town in which he can establish a high school. Or, he will lease an academy. Address, G., Lock Box 19, Suffern, N. Y.

WANTED.—By a lady-graduate of Cornell University, position as teacher in high school, seminary or college; prepared to teach the following branches, employing, so far as is practicable, the laboratory method: Geology, Botany, Zoölogy, Physiology; also, if desired, Physics, Chemistry, Logic and Psychology. References to heads of above-named departments in Cornell University. JENNIE T. MARTIN, care Cornell University, Ithaca, N. Y.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 47 Lafayette Place, New York.]

I wish to exchange a fresh and complete set of Weiss and Spier's "Necropolis of Aucon" for other books, either new or second-hand, if the latter are in good condition. What have you to offer? Address Warren Watson, Kansas City, Mo.

1,000 botanical specimens representing 250 genera in exchange for those not in my collection. Send list of duplicates, and receive a similar one to choose from. Address E. E. Bogue, Orwell, Ashta Co., Ohio.

For exchange—14 volumes (1883-1889) American Journal of Science, 10 volumes (1880-1889) American Naturalist, 21 volumes (1879-1890) English Mechanic, all in good condition for binding; also, Morris Typewriter. Wants first-class microscope, camera, chemical or physical apparatus. Address, with full particulars, E. R. Chadbourn, Lewiston, Maine.

Wanted.—To exchange land and fresh-water mollusca, (principally *Helices Achatinellae*, Clausiliae and Limnaeae,) for those not in my collection. Lists exchanged. Address E. H. White, Box 200, Astoria, Or.

Meteorites.—Mr. George F. Kunz, 11 to 15 Union Square, New York, or Hoboken, N. J., will buy or give in exchange for whole or parts of meteorites. Whole ones, undescribed ones, and entire falls especially desired.

Wanted—To furnish roots of *Dodecatheon Meadia*, *Sarracenia purpurea*, and other wild flowers, native of Southern Wisconsin, in quantities. D. E. Willard, Curator of Museum, Albion Academy, Albion, Wis.

I have a number of duplicates of microscopic slides, mostly botanical, which I would like to exchange for others not now in my collection. Send list of what you have to exchange and get my list. S. R. Thompson, New Wilmington, Pa.